



CCAMLR

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Comisión para la Conservación de los Recursos Vivos Marinos Antárticos

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**Joint report on exploratory fishing in Divisions 58.4.1 and 58.4.2  
between the 2011/12 and 2017/18 fishing seasons**

WG-SAM

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Delegations of Australia, France, Japan, Republic of Korea and Spain



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# Joint report on exploratory fishing in Divisions 58.4.1 and 58.4.2 between the 2011/12 and 2017/18 fishing seasons

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May 2018

## Abstract

Robust stock assessments and catch limits for *Dissostichus mawsoni* according to CCAMLR decision rules remain to be determined for Divisions 58.4.1 and 58.4.2, and precautionary management arrangements are in place as set out in Conservation Measures 41-11 and 41-05. WG-FSA-16/29 outlined the first multi-member toothfish exploratory fishery research plan for these Divisions, including research objectives, methods and milestones in accordance with ANNEX 24-01/A. Subsequent research progress has included updated toothfish habitat models and stock hypothesis (WG-FSA-17/16); updated ageing and growth estimation (WG-FSA-17/15, WG-FSA-17/66); investigation of sex ratios, gonadal development and validation of validation of macro- versus micro-staging of maturity (WG-FSA-17/09); investigation of approaches for mitigation of Macrourus by-catch in research block 58.4.1\_6, and estimation of Macrourus biomass and sustainable bycatch in Divisions 58.4.1 and 58.4.2 (WG-FSA-17/16); and description of encounter rates of VME indicator species (WG-SAM-16/34).

In this paper we report on exploratory fishing activities undertaken by Australia, France, Japan, Republic of Korea and Spain between the 2011/12 and 2017/18 fishing seasons, including the quantity of data and samples collected. Reports relating to specific research milestones for 2018 will be submitted to WG-FSA-18. The summaries provided herein were generated using an R-Markdown document which can be made available to Members to facilitate reporting on data collection in CCAMLR's Exploratory Fisheries.

## Fishing Activities

Four fishing voyages took place in the 2017/18 season, totaling 291 longline deployments (Table 1, Table 2, Fig. 1). Vessels and fishing systems used for exploratory fishing between the 2011/12 and 2017/18 seasons are listed in Table 1, and are described at <https://www.ccamlr.org/en/compliance/list-authorized-vessels>, and the CCAMLR Fishing Gear Library at <http://www.ccamlr.org/en/publications/fishing-gear-library>). Since the 2011/12 season, 1451 longline hauls have been deployed from 18 fishing voyages (Fig. 2). Fishing depths varied across areas; and overall they ranged from 606-2591 m, with a mean of 1330 m (Fig. 3). Fishing has occurred within research blocks, within research block buffer zones (as set out in Conservation Measure 41-01, ANNEX 41-01/B), and in other

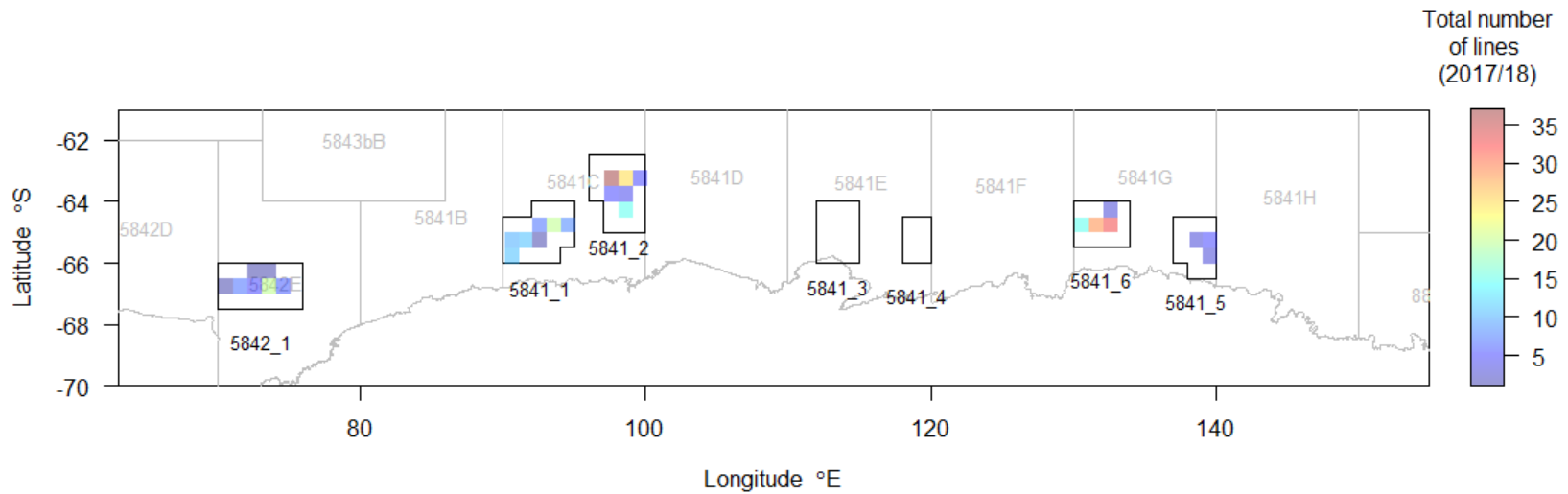
areas as part of depletion experiments and tagging undertaken by Spain (WG-SAM-16/10). Locations outside of research blocks are hereafter referred to as 'outside'.

*Table 1. Numbers of hauls for each vessel by fishing season (pooled across Divisions). Season is abbreviated to the end year.*

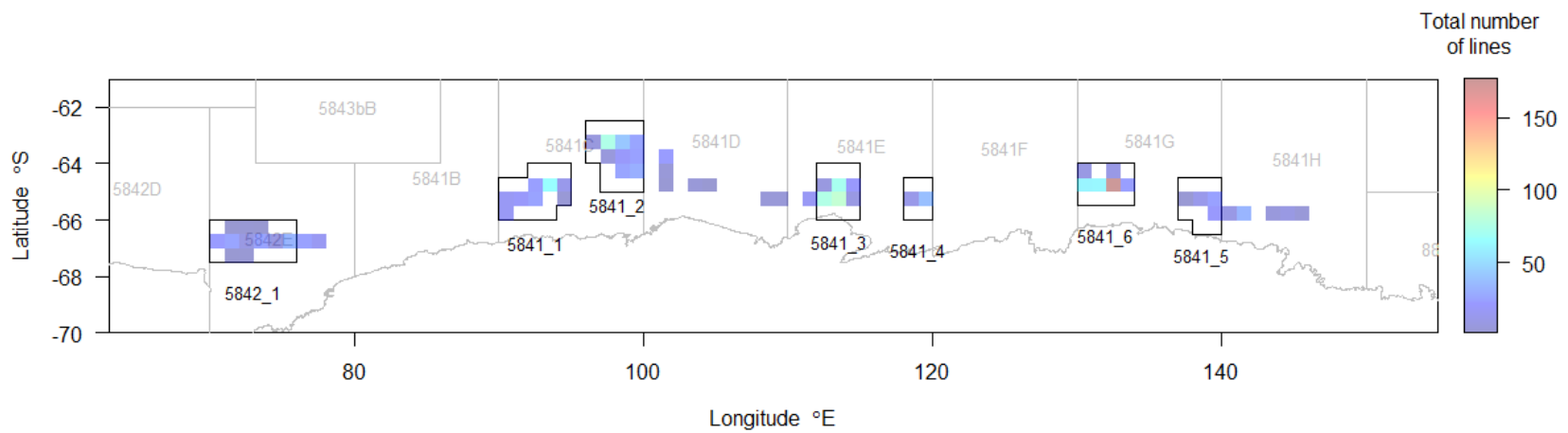
Member	Vessel	Fishing System	2012	2013	2014	2015	2016	2017	2018
AUS	Antarctic Chieftain	Autoliner							91
	Antarctic Discovery	Autoliner					82	29	29
ESP	Tronio	Spanish		42	83		96	74	139
		Trotline					1		
FRA	Saint Andre	Autoliner						14	32
JPN	Shinsei Maru No. 3	Trotline		21					
KOR	Hong Jin No. 701	Trotline	248						
	Insung No. 3	Spanish		10					
		Trotline		11					
	Kingstar	Trotline				123	158	146	
ZAF	Koryo Maru No. 11	Trotline	22						

*Table 2. Numbers of hauls per year, vessel and research block since research blocks were introduced in 2014. Values were calculated without consideration of research block buffer zones. Season is abbreviated to the end year.*

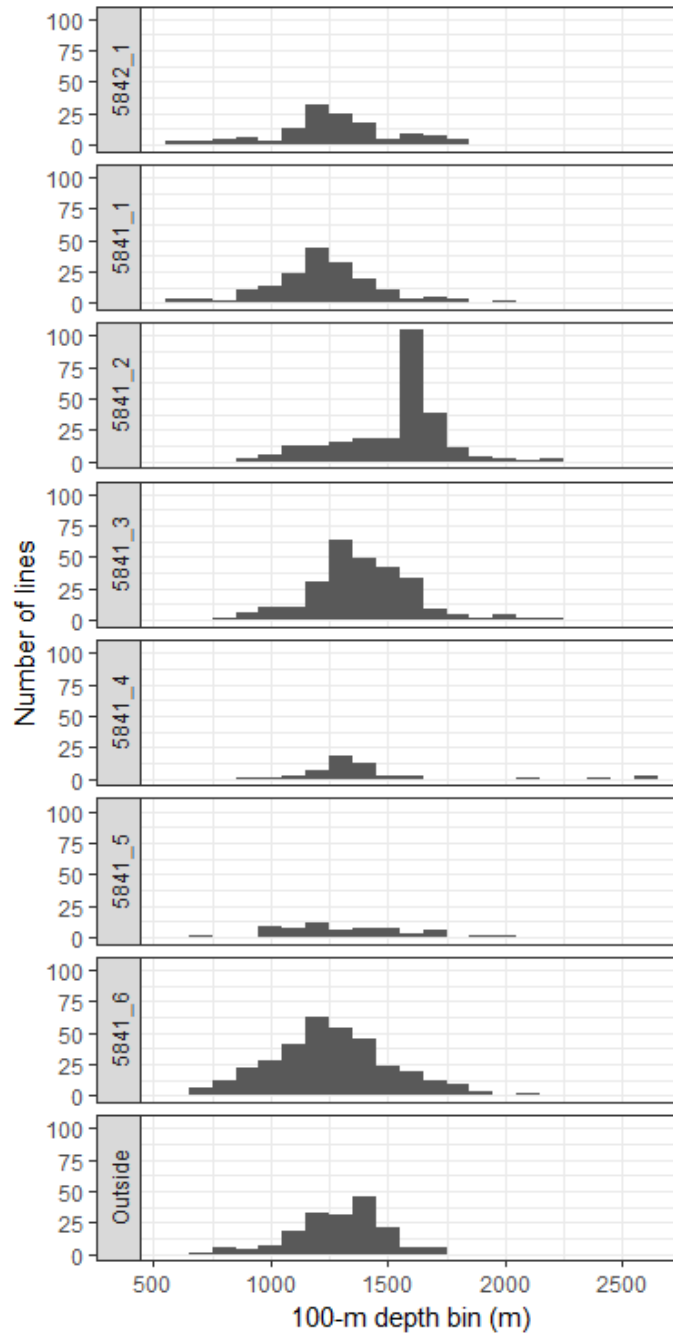
Season	Vessel	5842_1	5841_1	5841_2	5841_3	5841_4	5841_5	5841_6	Outside
2015	Kingstar	8		25	74	6	10		
2016	Antarctic Discovery				19	13		50	
	Kingstar		31	37	63		11		16
	Tronio							44	53
2017	Antarctic Discovery							29	
	Kingstar	11		34	75		26		
	Saint Andre	14							
	Tronio			1	22			51	
2018	Antarctic Chieftain	33	20	38					
	Antarctic Discovery						9	20	
	Saint Andre	8	24						
	Tronio		24	53			2	60	



*Fig. 1. Spatial distribution of fishing effort during the 2017/18 season by Australia, France and Spain. Shading indicates the number of longlines deployed. Raster cells are of size 1° longitude and 0.5° latitude. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.*



*Fig. 2. Spatial distribution of fishing effort since the 2011/12 season. Shading indicates the number of longlines deployed. Raster cells are of size 1° longitude and 0.5° latitude. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.*



*Fig. 3. Depth distribution of lines in Research Blocks of Divisions 58.4.1 and 58.4.2. Outside = lines outside of research blocks.*

## Total Catches

Total catches of *D. mawsoni*, *D. eleginoides* and *Macrourus* spp. were 1,441.5, 5 and 131.8 tonnes, respectively (Table 3). 'Outside' catches were calculated without consideration of research block buffer zones.

## Spatial and Depth Distributions of Catch

Total *D. mawsoni* catch has been spread across all research blocks of Division 58.4.1, and research block 5842\_1 in Division 58.4.2 (Fig. 4, Fig. 5), whereas mean catch rates of *Macrourus* spp. were relatively high within research blocks 5841\_5 and 5841\_6 and SSRU 58.4.1H (Fig. 6). Total catches were highest, and comprised predominantly of target species, between depths of 1000–1600 m (Fig. 7). Total catches generally declined in depths < 1000m and > 1500m, and were comprised of progressively larger proportions of bycatch species (Fig. 7). These observations are supported by distribution modelling undertaken in WG-FSA-17/18.

*Table 3. Summary of total catches across research blocks and seasons. Season is abbreviated to the end year.*

Research Block	Season	TOA (tonnes)	TOP (tonnes)	All GRV (tonnes)
5842_1	2012	22.1	0.0	0.1
	2013	3.7	0.0	0.1
	2015	9.6	0.0	0.0
	2017	34.6	0.0	1.3
	2018	41.7	0.2	5.1
	2012	82.0	0.0	0.5
	2013	2.9	0.0	0.0
	2016	79.7	0.0	0.4
	2018	96.1	0.1	4.2
	5841_2	2012	16.4	0.0
2013		0.1	0.0	0.1
2014		54.1	0.0	0.9
2015		15.4	0.0	0.2
2016		42.6	0.0	0.7
2017		51.1	0.0	1.4
2018		95.6	0.0	11.9
2012		28.3	0.0	0.1
5841_3	2015	71.3	0.0	1.1
	2016	60.0	0.0	7.6
	2017	70.3	0.0	6.9
	2012	22.4	0.0	0.3
5841_4	2015	9.9	0.0	0.1
	2016	12.1	0.0	5.0
	2015	25.7	0.0	0.5
5841_5	2016	34.9	0.0	0.8
	2017	31.7	0.0	2.0
	2018	7.5	0.0	2.9
	2012	8.2	0.0	0.4
5841_6	2013	23.1	0.2	1.6
	2014	24.3	0.6	1.5
	2016	84.2	1.2	18.8
	2017	53.3	1.5	15.3
	2018	65.1	0.8	16.1
	2012	31.0	0.0	0.8
Outside	2013	21.5	0.0	3.1
	2014	22.1	0.0	4.0
	2016	86.6	0.3	15.6



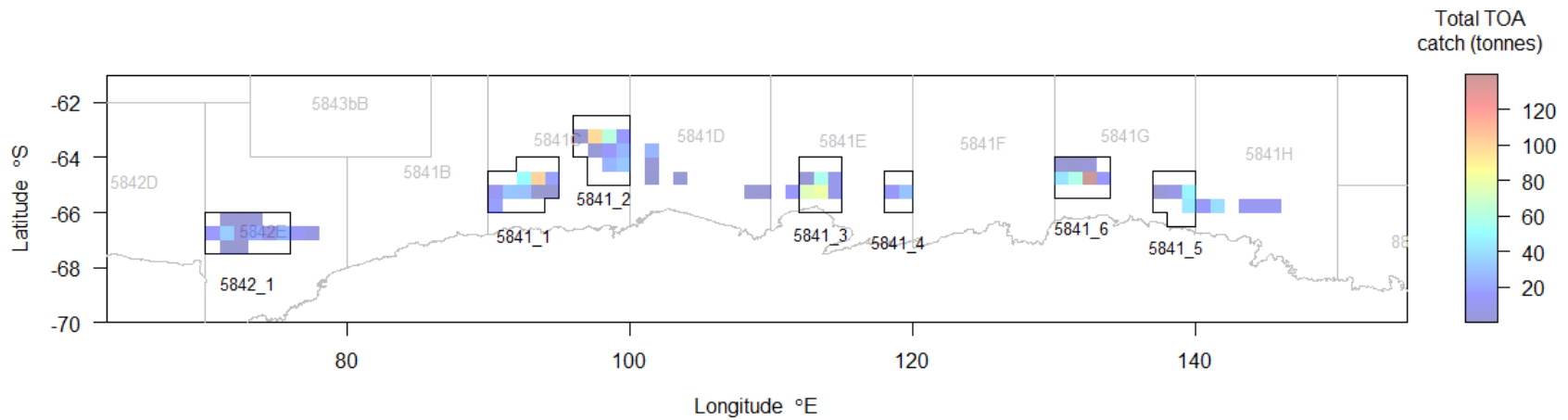


Fig. 4. Spatial distribution of *Dissostichus mawsoni* catch since the 2011/12 season. Shading indicates total catch (tonnes). Raster cells are of size 1° longitude and 0.5° latitude. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.

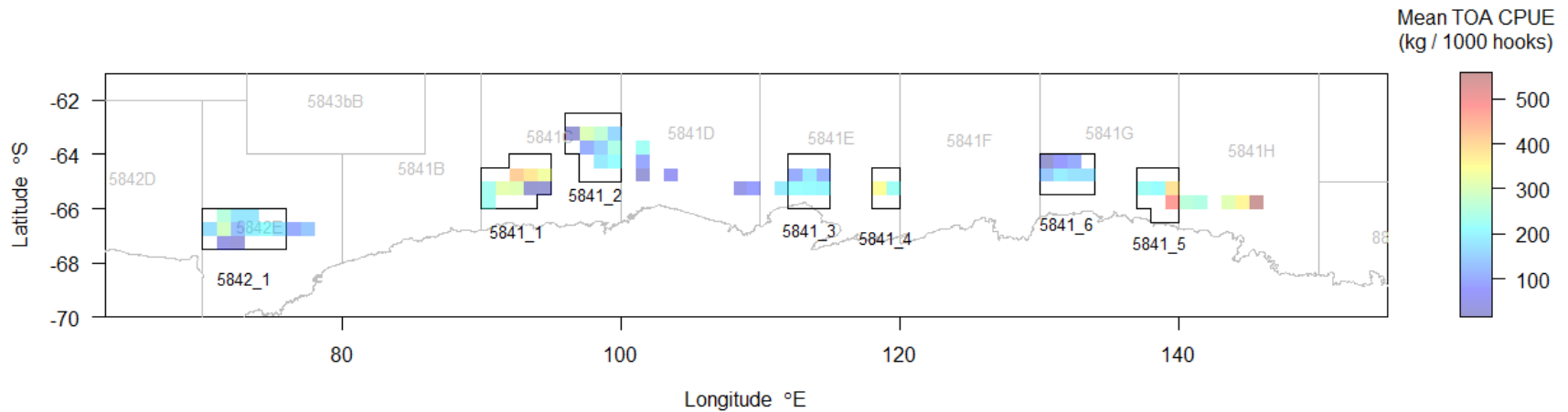


Fig. 5. Mean catch rates of *Dissostichus mawsoni* since the 2011/12 season. Raster cells are of size 1° longitude and 0.5° latitude. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.

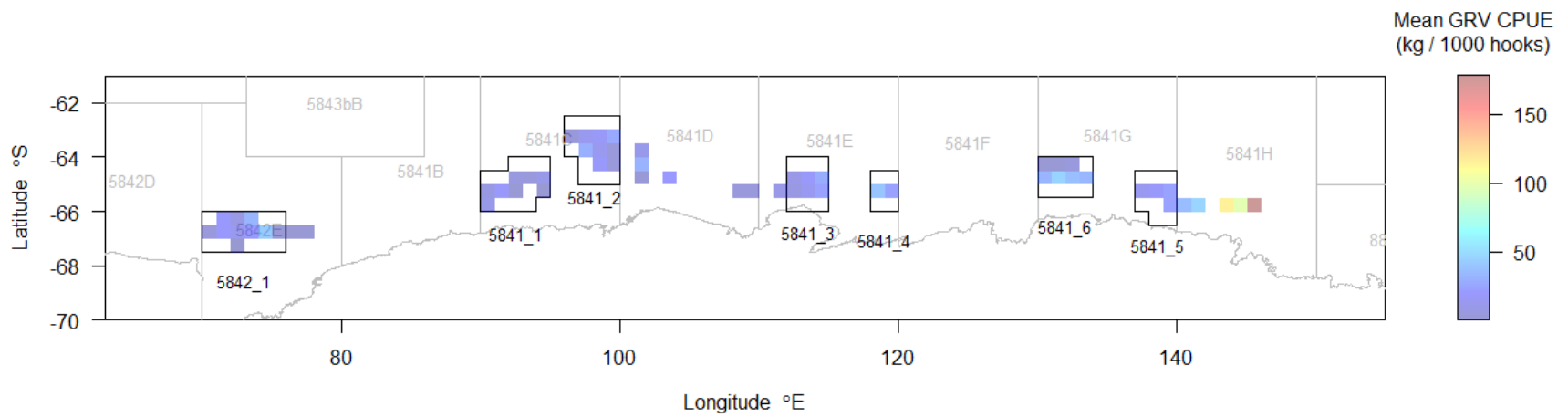


Fig. 6. Mean catch rates of *Macrourus* spp. since the 2011/12 season. Raster cells are of size 1° longitude and 0.5° latitude. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.

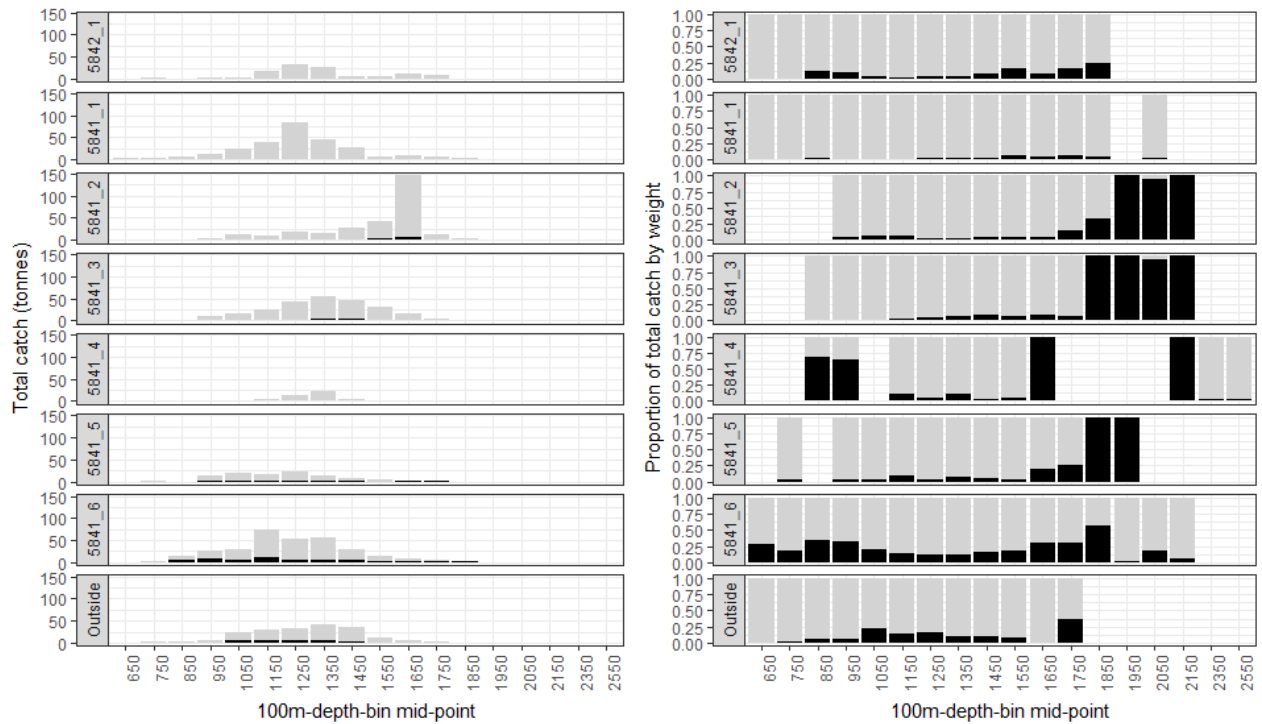


Fig. 7. Total catches of *Dissostichus mawsoni* (grey) and *Macrourus* spp. (black) species across depth bins and locations. Left panel = total catch in tonnes, right panel = relative proportions of *Dissostichus mawsoni* and *Macrourus* spp.

## Biological Sampling

In total, 31,526 and 27,743 *D. mawsoni* were measured for total length and weight, respectively; and 31,312 and 30,737 were assessed for sex and macroscopic maturity stage, respectively (Table 4). *Dissostichus mawsoni* ranged in size from 290–2,110 mm total length, with a mean total length of 1,377 mm.

*Table 4. Number of Dissostichus mawsoni sampled for biological parameters. Data are for all vessels and voyages pooled. Season is abbreviated to the end year.*

Research Block	Season	Length	Weight	Maturity	Sex
5842_1	2012	881	568	881	881
5842_1	2013	131	131	131	131
5842_1	2015	207	207	207	207
5842_1	2017	554	507	542	542
5842_1	2018	1290	1290	1290	1286
5841_1	2012	1772	1062	1772	1772
5841_1	2013	86	85	83	83
5841_1	2016	593	563	593	593
5841_1	2018	2026	2026	2023	2019
5841_2	2012	517	350	517	517
5841_2	2013	2	2	2	2
5841_2	2014	1216	707	1215	1215
5841_2	2015	340	340	339	339
5841_2	2016	563	563	561	561
5841_2	2017	574	574	574	574
5841_2	2018	2242	2242	2239	2230
5841_3	2012	255	159	255	255
5841_3	2015	1598	1598	1545	1545
5841_3	2016	961	965	960	960
5841_3	2017	1455	1455	1454	1453
5841_4	2012	554	428	554	554
5841_4	2015	163	163	162	162
5841_4	2016	230	244	250	250
5841_5	2015	327	327	294	294
5841_5	2016	344	344	264	264
5841_5	2017	443	443	442	442
5841_5	2018	185	192	192	192
5841_6	2012	393	281	393	392
5841_6	2013	575	506	571	572
5841_6	2014	645	497	643	643
5841_6	2016	2307	1957	2011	2329
5841_6	2017	1464	1463	1463	1457
5841_6	2018	1554	1561	1546	1551
Outside	2012	1397	926	1397	1397
Outside	2013	555	429	552	552
Outside	2014	864	744	855	855
Outside	2016	2263	1844	1965	2241
Total		31526	27743	30737	31312

## Otolith Collection and Ageing

A total of 11,505 otolith pairs were sampled from measured *D. mawsoni*. Summaries of the numbers of *D. mawsoni* otolith samples across length bins, Members, research blocks and seasons are provided in Table 5, Table 6, and Table 7.

*Table 5. Number of Dissostichus mawsoni sampled for otoliths in each 50-mm length bin between seasons 2011/12 and 2017/18.*

50-mm length-bin lower limit	Number of samples
250	0
350	2
400	0
450	1
500	3
550	16
600	57
650	125
700	159
750	119
800	128
850	128
900	113
950	158
1000	166
1050	226
1100	299
1150	398
1200	524
1250	742
1300	963
1350	1286
1400	1356
1450	1404
1500	1111
1550	814
1600	574
1650	319
1700	179
1750	74
1800	38
1850	11
1900	8
1950	3
2100	1

*Table 6. Number of Dissostichus mawsoni otolith samples by season and Member. Numbers of otoliths aged are in parentheses. Season is abbreviated to the end year.*

Season	AUS	ESP	FRA	JPN	KOR	ZAF
2012	0	0	0	0	315	0
2013	0	696 (514)	0	122	85	0
2014	0	1262 (495)	0	0	0	0
2015	0	0	0	0	1027	0
2016	344 (329)	562 (341)	0	0	910	0
2017	212	387	145	0	1344	0
2018	2547	1762	310	0	0	0

*Table 7. Number of Dissostichus mawsoni otolith samples by season and Research Block. Numbers of otoliths aged are in parentheses. Numbers of otoliths aged are in parentheses. Season is abbreviated to the end year.*

Season	5842_1	5841_1	5841_2	5841_3	5841_4	5841_5	5841_6	Outside
2012	28	70	39	5	47	0	99	27
2013	122	83	2	0	0	0	305 (ESP:261)	391(ESP:231)
2014	0	0	453 (ESP:173)	0	0	0	374 (ESP:139)	435 (ESP:185)
2015	50	0	204	620	62	92	0	0
2016	0	189	167	402 (AUS: 40)	40 (AUS: 39)	81	715 (AUS: 250, ESP:289)	211 (ESP:52)
2017	246	0	282	770	0	294	491	0
2018	1046	1053	1288	0	0	78	665	0
Total	1492	1395	2435 (173)	1395 (40)	109 (39)	545	1934 (939)	1064 (468)



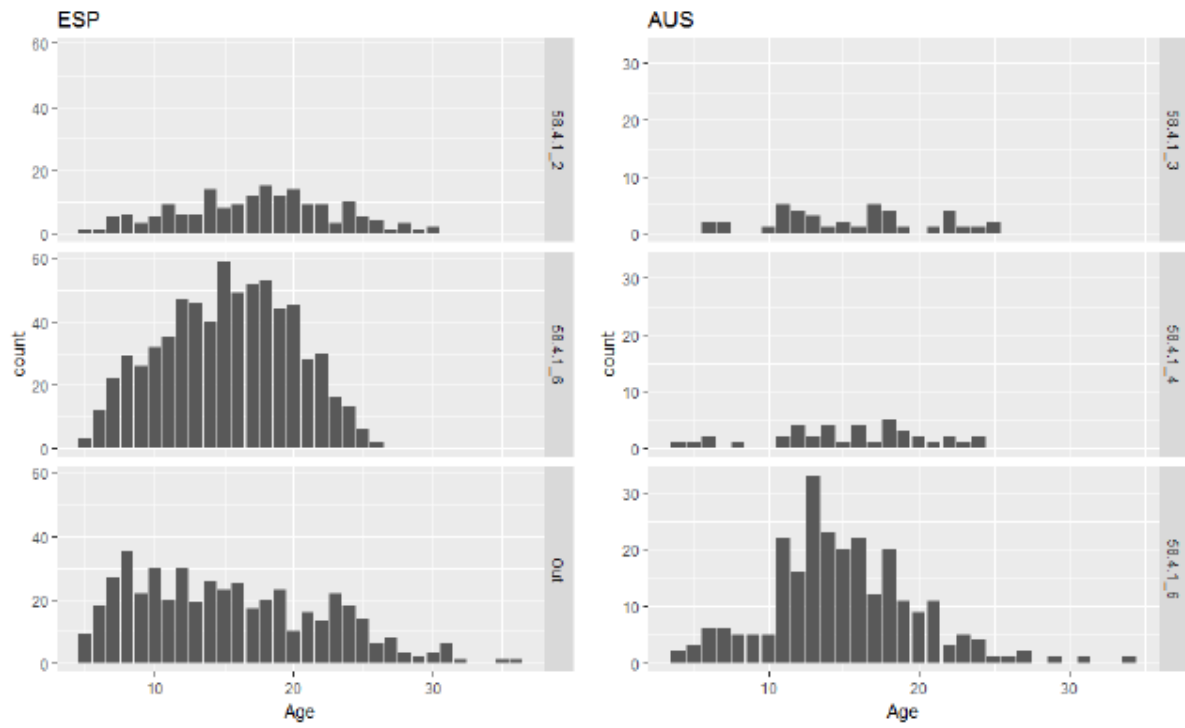


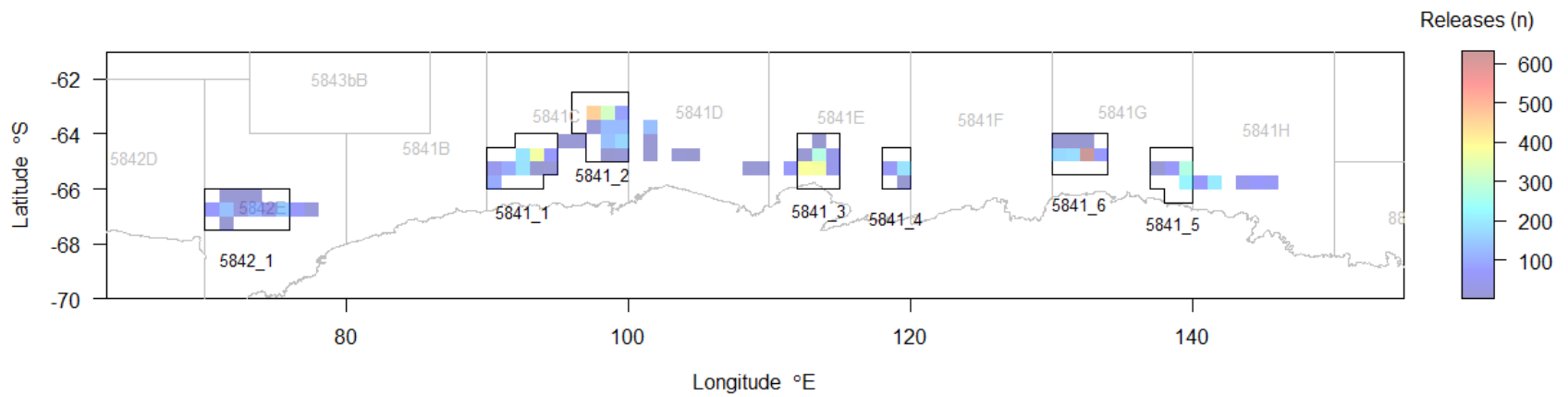
Fig. 8. Age-frequency plots by member and Research Block.

## Tagging

A total of 6,972 *D. mawsoni* were tagged and released between January 2011 and February 2018 (Fig. 9, Table 8). There have been 58 tag recaptures of *D. mawsoni* which could be matched with their release event (Table 10, Fig. 10, Fig. 11, Appendix 1), 14 of which were released and recaptured during the same season. Excluding within-season season recaptures, time at liberty ranged from 312 to 2912 days, and minimum straight-line distances travelled between capture events ranged from 0 to 1696 km (Table 10).

*Table 8. Number of Dissostichus mawsoni recaptures and releases in each season and research block. Within-season recaptures are excluded. Season is abbreviated to the end year.*

Season	5841_1		5841_2		5841_3		5841_4		5841_5		5841_6		5842_1		Outside	
	Rec.	Rel.	Rec.	Rel.	Rec.	Rel.	Rec.	Rel.	Rec.	Rel.	Rel.	Rec.	Rel.	Rel.	Rec.	
2011		123	1	224					2	37		14				14
2012		384		122		118		138				50		117		149
2013		29										116		20		111
2014			1	281								128			3	113
2015				84		355		50	3	135				82		
2016	1	400		211	3	296		60	1	178		421			1	437
2017			1	261	4	358			1	177	4	274		186		
2018		133	14	262						32	4	58		140		94
Total	1	1069	17	1445	7	1127	0	248	7	559	8	1061	0	545	4	918



*Fig. 9. Spatial distribution of tagged-and-released *Dissostichus mawsoni*. Shading indicates total number of releases. Raster cells are of size 1° longitude and 0.5° latitude. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.*

*Table 9. Tagging rates and size-overlap statistics for vessels that participated in the 2017/18 season.*

Vessel	Member	Rate	Overlap
Antarctic Chieftain	AUS	5.1	86.5
Antarctic Discovery	AUS	5.0	87.3
Saint Andre	FRA	5.7	67.0
Tronio	ESP	5.01	71.0

*Table 10. Summary of recaptured *Dissostichus mawsoni* with matched release and recapture events. Season is abbreviated to the end year.*

Sex	Release length (cm)	Release vessel	Recapture vessel	Release season	Recapture season	Days at liberty	Min. distance travelled (km)
NA	83	Insung No. 2	Hong Jin No. 701	2008	2011	1095	1
M	129	Shinsei Maru No. 3	Tronio	2010	2011	372	71
M	77	Shinsei Maru No. 3	Hong Jin No. 701	2010	2011	392	4
M	122	Tronio	Tronio	2011	2014	1096	23
F	112	Tronio	Tronio	2013	2014	380	2
M	115	Tronio	Tronio	2013	2014	379	47
F	126	Tronio	Tronio	2013	2014	374	2
F	154	Tronio	Tronio	2014	2014	1	2
F	147	Tronio	Tronio	2014	2014	1	3
F	85	Insung No. 2	Kingstar	2008	2015	2541	2
F	88	Insung No. 2	Kingstar	2008	2015	2542	14
U	78	Insung No. 1	Kingstar	2008	2015	2536	15
F	63	Argos Georgia	Kingstar	2008	2016	2912	1696
M	80	Hong Jin No. 701	Kingstar	2012	2016	1482	4
F	115	Tronio	Tronio	2013	2016	1090	9
M	145	Kingstar	Antarctic Discovery	2015	2016	392	33
F	144	Kingstar	Kingstar	2015	2016	367	7
M	150	Kingstar	Kingstar	2015	2016	370	10
M	106	Tronio	Tronio	2016	2016	14	2
F	148	Antarctic Discovery	Antarctic Discovery	2016	2016	6	13
F	158	Antarctic Discovery	Antarctic Discovery	2016	2016	5	9
F	60	Tronio	Tronio	2013	2017	1431	27
M	147	Kingstar	Kingstar	2015	2017	748	16
M	140	Kingstar	Kingstar	2015	2017	745	279
NA	136	Kingstar	Tronio	2015	2017	734	30
F	154	Kingstar	Kingstar	2015	2017	733	15

Table. 10 continued.

M	129	Kingstar	Kingstar	2016	2017	376	15
M	112	Tronio	Tronio	2016	2017	372	906
F	143	Tronio	Tronio	2016	2017	363	37
M	120	Tronio	Tronio	2016	2017	355	2
F	132	Antarctic Discovery	Antarctic Discovery	2016	2017	324	6
M	131	Tronio	Kingstar	2017	2017	8	29
M	102	Tronio	Antarctic Chieftain	2014	2018	1442	4
M	139	Kingstar	Antarctic Chieftain	2015	2018	1070	2
F	153	Kingstar	Antarctic Chieftain	2016	2018	712	697
F	136	Tronio	Tronio	2016	2018	742	14
F	148	Kingstar	Antarctic Chieftain	2017	2018	322	6
M	135	Kingstar	Antarctic Chieftain	2017	2018	315	11
M	161	Kingstar	Antarctic Chieftain	2017	2018	321	22
U	150	Kingstar	Antarctic Chieftain	2017	2018	315	3
F	152	Kingstar	Tronio	2017	2018	343	1
M	140	Kingstar	Antarctic Chieftain	2017	2018	320	3
F	141	Kingstar	Antarctic Chieftain	2017	2018	319	5
F	151	Kingstar	Antarctic Chieftain	2017	2018	316	16
M	151	Kingstar	Antarctic Chieftain	2017	2018	317	7
M	144	Kingstar	Antarctic Chieftain	2017	2018	312	18
F	160	Kingstar	Antarctic Chieftain	2017	2018	313	29
F	137	Kingstar	Tronio	2017	2018	375	372
M	133	Kingstar	Tronio	2017	2018	372	366
M	113	Antarctic Discovery	Tronio	2017	2018	364	49
M	137	Saint Andre	Tronio	2018	2018	NA	44
M	136	Saint Andre	Saint Andre	2018	2018	NA	3
F	122	Saint Andre	Tronio	2018	2018	NA	6
F	149	Antarctic Chieftain	Tronio	2018	2018	34	14
M	139	Antarctic Chieftain	Tronio	2018	2018	22	24
M	142	Antarctic Chieftain	Saint Andre	2018	2018	26	20
F	153	Tronio	Tronio	2018	2018	NA	7
U	140	Tronio	Tronio	2018	2018	NA	2

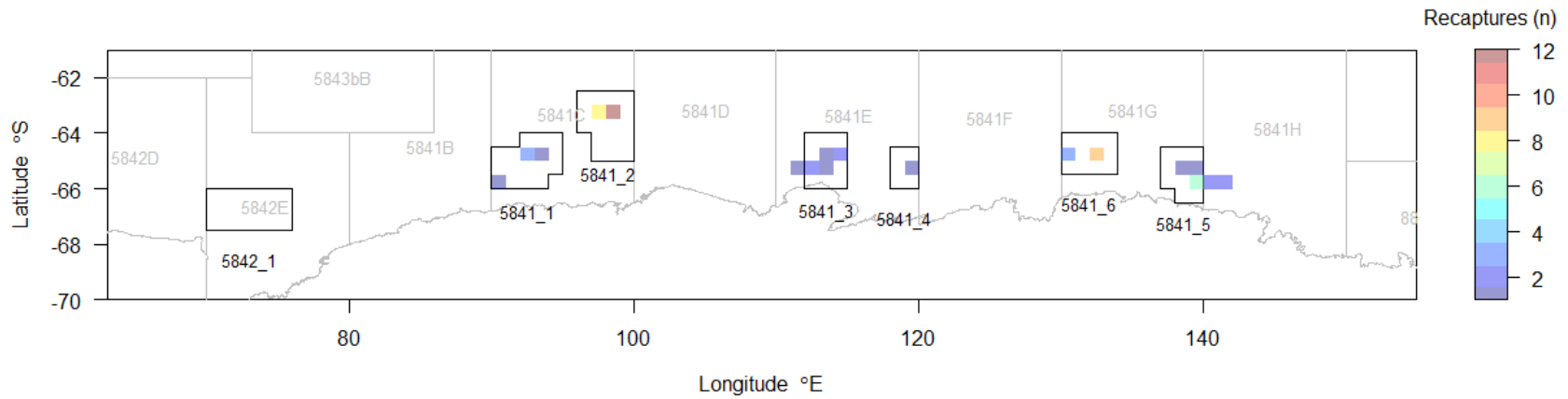


Fig. 10. Spatial distribution of tagged and recaptured *Dissostichus mawsoni* since the 2010/11 season. Shading indicates total number of recaptures. Raster cells are of size 1° longitude and 0.5° latitude. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.

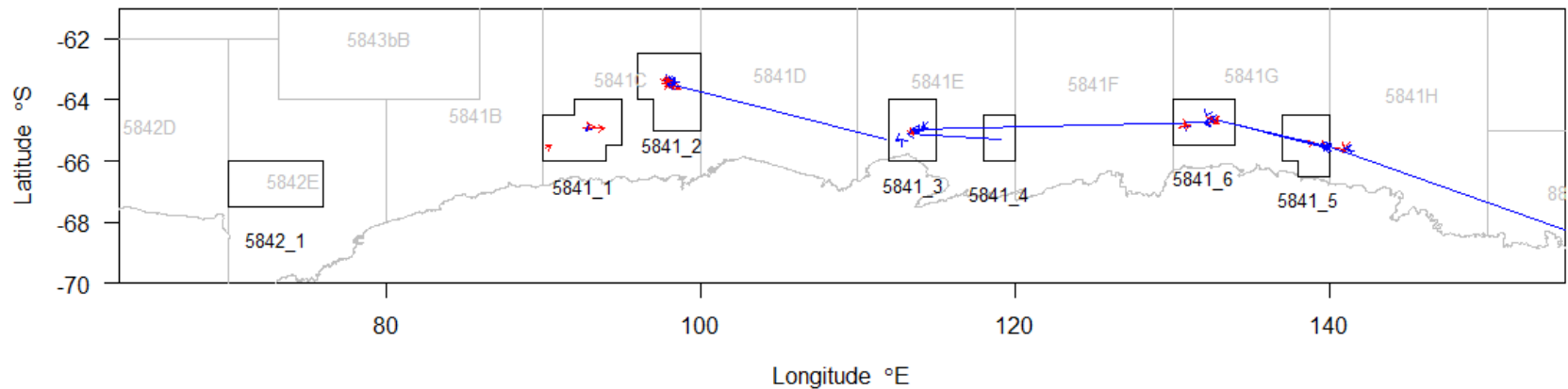


Fig. 11. Tagging and recapture locations for recaptured *Dissostichus mawsoni*. Arrows represent the shortest distance (and direction) between tagging and recapture locations for each individual. Blue arrows = westward movements, red arrows = eastward movements, grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.

## Environmental data collection

Between the 2014/15 and 2017/18 seasons conductivity, temperature and depth (CTD) recorders were attached to longlines to collect data on the biotic and abiotic conditions (Table 11). In addition, underwater video cameras were deployed by Australia during the 2015/16, 2016/17 and 2017/18 seasons.

*Table 11. Number of CTD and BVC deployments*

Season	Member	CTD	BVC
2015	AUS		
	KOR		
2016	AUS	33	15
	KOR		
2017	AUS	17	12
	KOR	33	
2018	AUS	74	48
	ESP		3

## Summary of progress towards research milestones

WG-FSA-16/29, and subsequently WG-FSA-17/18 Rev. 1, outlined the first multi-member toothfish exploratory fishery research plan up to 2017/18 for East Antarctica. Significant progress has been made in Divisions 58.4.1 and 58.4.2 over the course of the current research plan (Table 12).

### **Objectives of current research plan, WG-FSA-17/18 Rev. 1:**

**Objective 1:** Collect data required for an assessment of the status and productivity of toothfish stocks in Divisions 58.4.1 and 58.4.2. Standard catch, fishing effort, tagging and biological data will be collected under Conservation Measures 41-05 and 41-11.

**Objective 2:** Collect and utilise environmental data to inform spatial management approaches for the conservation of toothfish, bycatch species and representative areas of benthic biodiversity.

**Objective 3:** Collect data on the spatial and depth distributions of bycatch species, and inform bycatch mitigation measures.

**Objective 4:** Improve understanding of trophic relationships and ecosystem function to assist the development of ecosystem-based fisheries management approaches.

Note that a succeeding research plan for multi-member research on the *Dissostichus mawsoni* exploratory fishery in Divisions 58.4.1 and 58.4.2, from 2018/19 to 2021/22, has been submitted to WG-SAM-18. Based on WG-SAM-18 discussions and final milestone results for the current research plan, the research participants will further develop the objectives and the locations of research blocks of the succeeding research plan for WG-FSA-18.



Table 12. Objectives and Milestones for 2018 under the current research plan, WG-FSA-17/18 Rev. 1

Objective	Milestones for 2018	Research coordination	Progress and plans up to WG-SAM-18
Objective 1	1.8 Ageing of collected toothfish otoliths & updated estimation of growth parameters	Spain	<p>Papers on ageing progress submitted by AUS (WG-FSA-17/15) and ESP (WG-FSA-17/66).</p> <p>AUS and ESP will exchange TOA otolith samples during WG-SAM-18 for inter-lab comparison, and reporting to WG-FSA-18.</p> <p>AUS is developing a reference collection of TOA otolith images. AUS, KOR and ESP have read the TOA otolith reference collection.</p> <p>The next research plan will include greater capacity in otoliths ageing, which will be undertaken by all members who fish in 58.4.1 or 58.4.2 under this research plan.</p>
	1.9 Updated estimation of toothfish maturity parameters	Republic of Korea	<p>Description of sex ratios, gonadal development and validation of macro-versus micro-staging of maturity were presented in WG-FSA-17/09.</p> <p>Maturity ogives and estimates of length at maturity will be presented by KOR to WG-FSA-18.</p>
	1.10 Initial integrated stock assessment models for toothfish within research blocks or across SSRUs and Divisions	Australia, France, Japan and Spain	<p>Habitat models and the stock hypothesis were updated in WG-FSA-17/16.</p> <p>Progress towards population estimation in the regions will be presented at WG-FSA-18, along with a new research plan.</p> <p>Current genetics work (WS-DmPH-18/08) will provide information on whether <i>D. mawsoni</i> is suitable for an abundance estimate using close-kin mark-recapture methods. Preliminary results will be presented at WG-FSA-18.</p> <p>Movements of <i>D. mawsoni</i> based on results of archival tagging undertaken by KOR will be presented at WG-FSA-18.</p>
Objective 2	2.2 Update spatially-explicit habitat-use models for toothfish using data from CTDs and BVCs	Australia	<p>Numbers of BVC and CTD deployments are provided in Table 11.</p> <p>Current genetics work (WS-DmPH-18/08) will provide information of the stock structure of <i>D. mawsoni</i> in East Antarctica in relation to the wider</p>

			Southern Ocean. Preliminary results, including evaluation of the current stock hypothesis, will be presented at WG-FSA-18.
	2.3 Sharing of environmental data with SOOS	Australia	Will be presented at WG-FSA-18.
Objective 3	3.1 Estimation of spatial distribution, relative abundance, and life history of main bycatch species	Australia and France	Will be presented at WG-FSA-18.  Development of approaches for mitigation of <i>Macrourus</i> bycatch in research block 5841_6, and estimation of <i>Macrourus</i> biomass and sustainable bycatch in Divisions 58.4.1 and 58.4.2: WG-FSA-17/16.  Description of encounter rates of VME indicator species: WG-SAM-16/34.
Objective 4	4.3 Estimates of trophic relationships and ecosystem function using stable isotope analyses	Republic of Korea	20 plankton samples and 338 <i>D. mawsoni</i> muscle, liver and gill samples during 2015/16 (WG-SAM-16/28). [UPDATE?]  Next-generation sequencing of stomach contents collected from <i>D. mawsoni</i> : WG-FSA-17/P03.  Results of stomach content analyses from 2015/16 - 2017/18 will be presented at WG-FSA-18.

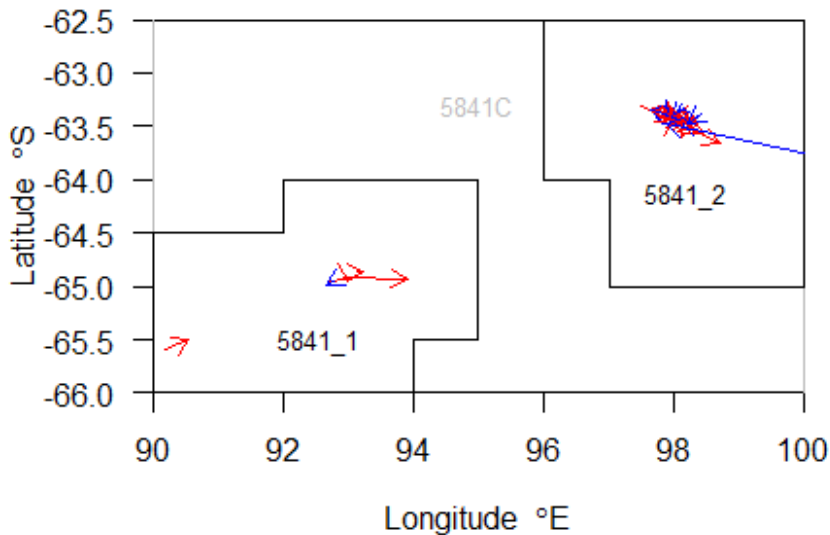
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## Appendix

Appendix 1. Close-up views of tagging and recapture locations for recaptured *D. mawsoni*. Arrows represent the shortest distance (and direction) between tagging and recapture locations for each individual. Blue arrows = westward movements, red arrows = eastward movements, grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. One individual captured in Research Block 5841\_5 was released 916 nm away in SSRU 88.1H. Grey lines = SSRU boundaries, black lines = CCAMLR Research Blocks. Map datum = WGS84.



Appendix 1 continued:

